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| C:\Users\David\Dropbox\rossmoyne.png  **Reading Time**: An initial **2 minutes** to view **BOTH** sections | **MATHEMATICS METHODS : UNITS 3 & 4, 2022**  Test 3 – (10%) 3.3.1 to 3.3.16, 4.1.1 to 4.1.3, 4.1.5, 4.1.7 | | |  |
| **Time Allowed**  21 minutes | | **First Name Surname  SOLUTIONS** | **Marks**  24 marks | |

**Circle your Teacher’s Name:** Mrs Alvaro Mrs Bestall Mrs Fraser-Jones Mr Gibbon/Luzuk Mrs Greenaway Mr Koulianos Mr Luzuk Mrs Murray Mr Tanday

|  |  |
| --- | --- |
| **Assessment Conditions: *(N.B. Sufficient working out must be shown to gain full marks)***   |  | | --- | | * Calculators: Not Allowed * Formula Sheet: Provided * Notes: Not Allowed | |

**PART A – CALCULATOR FREE**

Question 1 [1,2 - 3 marks]

Given that  and  , express the following in terms of  and/or 

1. 



✓ Correct answer

1. 



✓ Splits into 2 log terms

✓ Correct answer

Question 2 [1,2,2 - 5 marks]

Simplify each of the following expressions, expressing your answer in the form of a single

logarithm, ****

1. 

****

✓ Correct answer

1. 

****

✓ Splits into 2 log terms

✓ Correct answer

1. ****

****

✓ Combines into single log term

✓ Correct answer

Question 3 [1, 3, 2 - 6 marks]

For a certain population, the probability of a person being born with a specific gene SPGE1 is 

The probability of a person having this gene is independent of any other person in the population

having this gene.

In a randomly selected group of 3 people, determine the probability that;

1. none out of the three have the gene.

****

✓ Correct answer

1. less than two have the gene

Let X be the number of people with the gene

✓ Defines distribution (allow mark if defined in part (a))

✓ Substitutes values into binomial formula

✓ Correct answer





1. none have the gene, given that less than two have the gene.



✓ Sets up conditional probability

✓ Correct answer

Question 4 [1,4,3 - 8 marks]

Solve for **** , leaving answers as **exact** values

1. ****



✓ Correct answer

1. ****



✓ Writes constant as a log

✓ Rearranges to form quadratic

✓ Discards *x* = 0 to get correct answer

(-1 if *x* = 0 not given as a possible solution)

1. 



✓ Takes logs of both sides

✓ Rearranges to get *x* on one side

✓ Correct answer, simplified

**OR**



✓ Expression that includes 3*x* and 2*x*

✓ Forms exponential equation

✓ Correct answer

Question 5 [2 marks]

The random variable *X* has the following probability distribution, where 



If , show that 



✓ Equation for variance in terms of *p*

✓ Expansion of sum terms and binomial

**End of section**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| C:\Users\David\Dropbox\rossmoyne.png  **Reading Time**: An initial **2 minutes** to view **BOTH** sections | **MATHEMATICS METHODS : UNITS 3 & 4, 2022**  Test 3 – (10%) 3.3.1 to 3.3.16, 4.1.1 to 4.1.3, 4.1.5 , 4.1.7 | | |  |
| **Time Allowed**  27 minutes | | **First Name Surname  SOLUTIONS** | **Marks**  31 marks | |

**Circle your Teacher’s Name:** Mrs Alvaro Mrs Bestall Mrs Fraser-Jones Mr Gibbon/Luzuk Mrs Greenaway Mr Koulianos Mr Luzuk Mrs Murray Mr Tanday

|  |  |
| --- | --- |
| **Assessment Conditions: *(N.B. Sufficient working out must be shown to gain full marks)***   |  | | --- | | * Calculators: Allowed * Formula Sheet: Provided * Notes: Not Allowed | |

**PART B – CALCULATOR ALLOWED**

Question 1 [3 marks]

Identify each of the following experiments as Binomial or not Binomial. For those identified as Binomial, **state the distribution**. For those identified as not Binomial, **state a reason**.

1. The number of hearts dealt in a hand of 5 cards from a shuffled deck of 52 cards

Not binomial

*  is not constant

✓ Correct answer

* successive events are not independent

1. Spinning a spinner numbered 1 to 8 **ten** times, and counting the number of even numbers

that occur.

✓ Correct answer

Binomial – 

1. Flipping a fair coin and noting the number of flips required before a tail is observed

Not binomial – number of trials is not set

✓ Correct answer

Question 2 [2 marks]

Three discs are drawn from a bag containing **three blue** and **two green** discs. If a disc is replaced after each selection, find the probability distribution for the random variable , the number of blue discs drawn.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 |
|  | 0.064 | 0.288 | 0.432 | 0.216 |

✓✓ Correct values (-1 per error)

Question 3 [2 marks]

A discrete random variable X has a binomial distribution with a probability of success of p = 0.1

for **n** trials, where n > 2. If the probability of obtaining at least two successes after **n** trials is at

least 0.5, determine the smallest possible value of **n**.



✓ Defines distribution

✓ Correct answer

Full marks for answer only.

Question 4 [2,2,2 - 6 marks]

The probability distribution of a discrete random variable,  , is given in the table below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 | 4 |
|  | 0.2 |  | 0.1 |  | 0.1 |

1. Determine the possible value(s) of .



✓ Equates sum of probabilities to 1

✓ Correct values

1. Let 
2. Calculate 



✓ Correct answer

1. Find 



✓ Shows *P*(*X* ≥ 2)

✓ Correct answer (fraction or decimal)

Question 5 [2 marks]

The binomial variable,  , has  and 

Determine the parameters  and 



✓ Sets up 2 equations with expected value and variance

✓ Correct values

Question 6 [1, 2 - 3 marks]

The probability distribution function of a random variable,  , is shown below

|  |  |  |
| --- | --- | --- |
|  | 0 | 1 |
|  | 0.3 | 0.7 |

1. Determine 



✓ Correct answer

1. Determine  if 



✓ Calculates Var(X)

✓ Correct Var(Y)

Question 7 [1,2,3 - 6 marks]

In the general population, it is estimated that 15% of males suffer from **Kitchenitus**

1. If a study group of 40 males is selected and tested, how many of the study group would you   
   expect to have kitchenitus?



✓ Correct answer

Would expect 6 males to have kitchenitus.

1. If a study group of 10 males is selected and tested, determine the probability that

**two** (2) of the males have kitchenitus

Let X be the number of males who have kitchenitus.

✓ Defines distribution

✓ Correct answer



1. Determine the probability that it takes a selection of 10 males before 4 males with

**the condition** have been selected.

Let Y be the number of males out of 9 who have kitchenitus.



✓ Defines new distribution

✓ Indicates 3 out of first 9, plus 10th

✓ Correct answer

Question 8 [1,3,3 - 7 marks]

A spinning wheel at a country fair has 15 numbers, 1-15. Each number has an equal chance of occurring.

A player pays $5 for one game. If a multiple of 4 occurs, the player receives their $5 back plus another $5 . If a 1 or 15 occurs, the player receives their $5 back plus another $10.

Otherwise, the player loses their $5.

1. Calculate the probability of a player winning $5 in one game



✓ Correct answer

1. Calculate the expected gain for the player, when one game is played.

Let X be the profit earned by the player per game.

|  |  |  |  |
| --- | --- | --- | --- |
| Outcome | 1, 15 | 4, 8, 12 | Others |
| Prize | $10 | $5 | 0 |
|  | 10 | 5 | -5 |
|  |  |  |  |

✓ Defines PDF (rows 3 and 4)

✓ Calculates E(X)

✓ States loss



Therefore, the player can expect a loss of $1.

1. To make the game fair, the cost for the game is reduced. Find the new cost for

playing one game.

Let Y be the profit earned by the player per game when the cost is $*x*.

|  |  |  |  |
| --- | --- | --- | --- |
| Outcome | 1, 15 | 4, 8, 12 | Others |
|  | 10 | 5 |  |
|  |  |  |  |



✓ Calculates expected value in terms of cost

✓ Sets to 0 for fair game (to break even)

✓ Correct cost of game

**End of section**